

Estimation of Production Cost of Extended Restructured Mutton Chops Developed by Incorporating Pre-Optimized Level of Different Bind Enhancing Agents

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Abstract

Along with nutritive value and sensory acceptability of meat product, economics is also very important criteria that determine the marketability of any product. The characteristics of mutton such as high nutritive value and its gradual increasing demand in other countries provide a wide scope for its use in meat products processing. But in order for the meat sheep producer to survive, new avenues for marketing mutton must be created and it can be best accomplished by the production of value added products with appeal to Indian consumers. Therefore, the present study was envisaged to determine the production cost of extended restructured mutton chops by incorporating pre-optimized level of different bind enhancing agents i.e tamarind seed powder (1%), flaxseed flour (1%), gum tragacanth (0.1%) and gum acacia (0.5%) and compared with control and it was found that the cost of 1 kg product was worked out to be Rs. 244, 237, 240, 245 and 245 for control and treatments including TSP, FF, GT and GA respectively. The studies indicated that out of four bind enhancing agents, two of them i.e TSP and FF resulted in reduction in cost of ERMC by Rs.6 and Rs.3per kg, respectively as compared to control. Hence, it could be inferred that restructured mutton chops could be prepared with 10% extension and the quality can also be improved with 1% TSP incorporation to make it a profitable enterprise.

Keywords: Extended restructured mutton chops; Cost analysis; Tamarind seed powder; Flaxseed flour; Gum tragacanth; Gum acacia

Introduction

Due to the changing consumer demand and increasing global competition, new processing technologies and new ingredient systems are embraced by meat product manufacturing sector and this is remarkable if one considers the historically traditional and long term approach to product and process development in the meat industry. One such approach is the innovative restructuring technology, wherein low value pieces of lean meat are assembled into new shapes and forms that create a premium product at a significantly lower price point [1]. Since, mutton has not been explored much in this area, thus, attempts need to be made to develop restructured products out of mutton, which may help in popularizing it in India. Mutton is excellent source of high biological value protein, vitamin B₁₂, niacin, vitamin B₆, iron, zinc and phosphorus and source of long-chain omega-3 PUFA and also act as sources of a range of endogenous antioxidants and other bioactive substances including taurine, carnitine, carnosine, ubiquinone, glutathione and creatine [2]. In addition, it has no religious inhibitions and is consumed by all the religions and races in the country [3]. Thus, the characteristics of mutton such as high nutritive value and its gradual increasing demand in other countries provide a wide scope for research. But in order for the meat sheep producer to survive, new avenues for marketing mutton must be created and it can be best accomplished by the production of value added products with appeal to Indian consumers, as well as current ethnic consumers and obviously, which should result in increased profitability of the meat sheep. However, the two major challenges associated with successful marketing of mutton to expanded market consumers are its flavor and cost. Thus, it becomes a major challenge to develop a cost-effective mutton processed product that will be cost competitive with similar beef and pork products.

In view of this, development of extended restructured mutton chops was carried out which were incorporated with pre-optimized levels of different bind enhancing agents i.e, Tamarind seed powder, flaxseed

flour, gum tragacanth and gum acacia. Extension of the product was brought about by the addition of pre-optimized levels of extenders (i.e peahull flour (5%) and boiled and mashed potato (5%)) based on cooking yield and sensory attributes. Addition of extenders in product proves to be profitable venture for meat processors as it results in reduction of production cost however, extension of the product usually results in poor binding, texture and overall acceptability of product [4], which was dealt, here with incorporation of bind enhancing agents. The seed material of *Tamarindus indica L.* has proven to be suitable for wider utilization as an alternate food in India [5]. They are excellent sources of protein, starch, dietary fiber, micronutrients and bioactive compounds with low levels of fat [6]. Flaxseed is ranked among the very important functional foods because of its very high content of alpha-linolenic acid, dietary fiber, lignin, flavonoids, phenolics and good quality protein [7] Since, along with nutritive value and sensory acceptability of meat product, economics is also very important criteria that determine the marketability of any product [8]. Therefore, the present study was attempted in order to determine production cost of extended restructured mutton chops utilizing optimum levels of different bind enhancing agents viz., tamarind seed powder (1%), flaxseed flour (1%), gum tragacanth (0.1%) and gum acacia (0.5%) and compared with control.

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Material and Methods

Procurement of mutton and ribs

Sheep of age group 1-2 years were slaughtered and dressed in Experimental Abattoir of LPT Division, IVRI, Izatnagar. Mutton, thus obtained was packed in clean polyethylene bags and brought to the laboratory. It was deboned manually. Ribs were also collected at the same time from the abattoir and cleaned off the meat with knife. Deboned mutton and ribs were finally packed in clean polyethylene bags and frozen at -20°C until use.

Bind enhancing agents

Tamarind seed and flaxseed flour were purchased from local market of Bareilly. Removal of testa of the tamarind seed was done by soaking it in water and then dried. Dried and decorticated seeds were powdered in the grinder for study purpose. Similarly, flaxseed were dried and powdered in the grinder and used for study purpose. Gum tragacanth and gum acacia were purchased from S.D. Fine Chemicals and Qualigens respectively.

Spices

Spice ingredients were purchased from the local market of Bareilly and freed from extraneous matter. These were dried in hot air oven at 50°C for 4 hours and grounded and sieved through a fine mesh. The powders were mixed in suitable proportion as reported by Verma et al. [9].

Condiments and other ingredients

For the preparation of condiments, onion was peeled off, cut into small pieces and homogenized in a mixer to obtain a fine paste. Garlic paste was purchased from the local market of Bareilly. Refined salt (Tata Chemicals Ltd., Mumbai), refined wheat flour (Maida), Pea hull flour and potato were procured from local market of Bareilly.

Preparation of extended restructured mutton chops

Mutton was cut into small (1cm) chunks and massaged in paddle mixer (Hobart Co. N50G) along with salt, sodium nitrite and Sodium Tripolyphosphate dissolved in chilled water. Refined wheat flour, spice mix and condiments were added one by one and massaged along with addition of pea hull flour and potato as extenders. The mix, so obtained, was bound to the ribs and given the shape of chops. Chops were wrapped in aluminium foil and kept for cooking (broiling). The formulation of Extended Restructured Mutton Chops (ERMC) incorporated with pre-optimized levels of bind enhancing agents is shown in Table 1.

In the present study, tamarind seed powder, flaxseed flour, gum tragacanth and gum acacia were used at their optimum level of 1%, 1%, 0.1% and 0.5% respectively, in extended restructured mutton chops by replacing lean meat in pre-standardized restructured mutton chops formulation. The production cost of the developed extended restructured mutton chops utilizing optimum level of bind enhancing agents was calculated and compared with control.

Cost analysis

A comparative cost analysis was performed to determine the approximate production costs of extended restructured mutton chops formulated with 1%TSP, 1% FF, 0.1% GT and 0.5% GA. The extended restructured mutton chops' production costs were also compared to control product formulation. The production cost of the extended

restructured mutton chops formulations was determined by adding the costs of the raw materials, electricity cost, maintenance cost and labor cost of manufacturing these products. The price of 260 Rs/Kg of mutton was obtained from the local market of Bareilly. In order to calculate the price of mutton used to make the restructured meat products, a meat yield of 86%, 88%, 87%, 86% and 87% for control and treatment product containing optimum levels of TSP, FF, GT and GA respectively. In order to simplify the cost analysis, this information was used to determine the processing cost that is made up of overhead and depreciation costs. In addition, the meat and non-meat ingredient costs along with the processing costs were added in order to produce a total cost per 100 kg batch [10].

Results and Discussions

Raw material cost

The major determinant of product cost is the raw material, which determines the profit earned by the producer. Raw materials for the processing of extended restructured mutton chops were lean meat, condiments, spices, salt, refined wheat flour (maida), peahull flour and boiled and mashed potato. The retail prices for these ingredients are relatively stable in our costing system. However, the cost of these ingredients can be lowered if purchased in bulk quantities from distributors/whole sale agents. The costs of ingredients/Kg and total raw material are presented in Table 2 and Table 3 respectively.

Depreciation cost of processing equipments

The essential equipments and accessories required for processing of extended restructured mutton chops and approximate cost of processing and other machineries required for the making of 100 kg extended restructured mutton chops are presented in Table 4.

$$\begin{aligned} \text{Depreciation rate} &= 10\% \text{ per annum} \\ &= 46,200/\text{annum} \\ &= \text{Rs. } 154/\text{day} \text{ (300 working days /annum)} \end{aligned}$$

These processing equipments can be utilized for making other meat

Ingredients	Control	T-I	T-II	T-III	T-IV
Lean meat(g/100g)	66.00	65	65.00	65.99	65.5
Ice flakes (g/100g)	12.00	12.00	12.00	12.00	12.00
Salt(g/100g)	1.75	1.75	1.75	1.75	1.75
Sodium Nitrite (mg/Kg)	150	150	150	150	150
Sodium Tripolyphosphate (g/100g)	0.50	0.50	0.50	0.50	0.50
Refined wheat flour (Maida) (g/100g)	3.00	3.00	3.00	3.00	3.00
Spice Mix (g/100g)	1.75	1.75	1.75	1.75	1.75
Condiments (g/100g)	5.00	5.00	5.00	5.00	5.00
Pea hull flour (1:1 hydration w/w) (g/100g)	5.00	5.00	5.00	5.00	5.00
Boiled and Mashed Potato (g/100g)	5.00	5.00	5.00	5.00	5.00
Tamarind seed powder (g/100g)	-	1.00	-	-	-
Flaxseed flour (g/100g)	-	-	1.00	-	-
Gum tragacanth (g/100g)	-	-	-	0.01	-
Gum acacia(g/100g)	-	-	-	-	0.50

Control= Extended restructured mutton chops.
 T-I= Extended restructured mutton chops with tamarind seed powder 1g/100g formulation.
 T-II= Extended restructured mutton chops with flaxseed flour 1g/100g formulation.
 T-III= Extended restructured mutton chops with gum tragacanth 0.1g/100g formulation.
 T-IV= Extended restructured mutton chops with gum acacia0.5g/100g formulation.

Table 1: General formulation for control and treatment extended restructured mutton chops.

products thus decreasing the cost of inventory items by their effective utilization in making a product.

Cost of electricity

Continuous supply of electricity is the basic need in processing plant

for the operation of various equipments and adequate illumination of working space. The electricity charges are elevated at an enhanced rate of Rs. 5.00/ KWh under industry category use. The cost of electricity incurred for processing of 100 kg of meat can be calculated as shown in Table 5.

S. No	Ingredients	Cost (Rs/kg)
1	Mutton	260
2	Water/Ice flakes	2
3	Table salt	12
4	STPP	200
5	Sodium nitrite	300
6	Refined wheat flour (maida)	12
7	Spice mix	200
8	Condiments	50
9	Pea hull flour	40
10	Potato	10
11	TSP	75
12	FF	100
13.	GT	1400
14.	GA	970

Table 2: Cost of ingredients/kg.

Ingredients	Control		TSP (1%)		FF (1%)		GT (0.1%)		GA (0.5%)	
	Qty (Kg)	Cost (Rs)	Qty (Kg)	Cost (Rs)	Qty (Kg)	Cost (Rs)	Qty (Kg)	Cost (Rs)	Qty (Kg)	Cost (Rs)
Mutton	66	17,160	65	16,900	65	16,900	65.9	17,134	65.5	17,030
Water/Ice flakes	12	24	12	24	12	24	12	24	12	24
Salt	1.75	21	1.75	21	1.75	21	1.75	21	1.75	21
STPP	0.5	100	0.5	100	0.5	100	0.5	100	0.5	100
Sodium nitrite	0.0015	0.45	0.0015	0.45	0.0015	0.45	0.0015	0.45	0.0015	0.45
Maida	3	36	3	36	3	36	3	36	3	36
Spice mix	1.75	350	1.75	350	1.75	350	1.75	350	1.75	350
Condiments	5	250	5	250	5	250	5	250	5	250
Peahull flour	5	200	5	200	5	200	5	200	5	200
Potato	5	50	5	50	5	50	5	50	5	50
TSP	-	-	1	75	-	-	-	-	-	-
FF	-	-	-	-	1	100	-	-	-	-
GT	-	-	-	-	-	-	0.1	140	-	-
GA	-	-	-	-	-	-	-	-	0.5	485
Total		18191.45		18096.45		18121.45		18305.45		18546.45

Table 3: Raw materials for 100 kg formulation of ERMC per day.

Equipments	No. of items required	Rate (Rs./item)	Total (Rs.)
Processing equipments			
Paddle mixer	1	70,000	70,000
Hot air oven	1	10,000	10,000
Impulse sealer	3	6,000	18,000
Weighing balance	5	12,000	60,000
Thermometer	1	200	200
Cooling equipments			
Refrigerators (500L)	2	20,000	40,000
Deep freezer (500L)	1	70,000	70,000
Split a/c (1.5 ton)	3	30,000	90,000
Utilities			
Gas burner setup	1	2,000	2,000
Gas cylinder	1	1,800	1,800
Geyser	2	10,000	20,000
Utensils and furnitures (knives, meat cutting boards and tables etc.)	--	--	80,000
Total			4,62,000

Table 4: Cost of processing equipments.

Therefore the cost of electricity = Rs 62.3/KWh x 5.00
= Rs.311.5 /day~ Rs. 312/day

Packaging cost

Extended restructured mutton chops were packed in low density polyethylene bags (LDPE bags). About 1.5 kg bags (22 cm x 15 cm) are needed to pack 100 kg of product, each containing 250 g finished product. 1.5 kg of printed LDPE bags cost Rs.180/day (Rs.120/kg). Thus cost of packaging material is Rs.180/day. Cartons are also required for bulk packing and storage for transportation and distribution.

Labor cost

Presently in India, the labor cost of skilled person is about Rs.250/day and that of unskilled person is around Rs.150/day. For making 100 kg ERM, one skilled and six unskilled labors are required per day.

The labor cost can be calculated as:

$$\begin{aligned} \text{Skilled staff} &= 250 \times 2 = \text{Rs. } 500/\text{day} \\ \text{Unskilled staff} &= 150 \times 3 = \text{Rs. } 450/\text{day} \\ \text{Total labor cost} &= \text{Rs. } 950/\text{day} \end{aligned}$$

Cost of water

Water is the most essential non food ingredient in food processing plant. The cost of water includes the cost of water pump sets, pipeline fitting and electricity incurred in pumping water. For processing 1 kg of ERM, approximately 15 liters of water is required. So, for 100 kg of

product, it is about 1500 liters of water/day. For pumping 1500 liters of water, one motor of 1 Horse Power is to be run for 1.5 hours which will utilize 1.5 units of electricity costing Rs. 7.5/day.

So, total cost of water/day can be calculated as follows:

$$\begin{aligned} \text{Cost of bore well, water storage tanks and 1 pump set} &= \text{Rs.}50,000/- \\ \text{Depreciation / year @ 10\%} &= \text{Rs.}5000/- \\ \text{i.e.} &= \text{Rs.}17/\text{day} \end{aligned}$$

Therefore, **total cost of water/day** = Rs.24.50 ~ Rs.25/-

Rent

Properly constructed building is the basic infrastructure required for processing plant. Renting a building large enough to run a small scale processing plant with all facilities will cost around Rs.10,000/month in semi urban areas. Working days in a month are about 25. So the cost of rent comes to about Rs.400/day.

Maintenance costs

These are incurred on materials of daily use like telephone, detergents, soaps, sanitizers, hand wash and solid waste material disposal etc. which can be taken approximately Rs.250/day

Total expenditure

The sum of all above cost (3.1 to 3.9) account for total cost for the production 50 kg of ERM per day are shown in the Table 6.

Equipments	Watt x hr	KWh
Paddle mixer	1000 x 1 x4	4.0
Impulse sealer	100 x 3	0.3
Refrigerator	150 x 2 x 20	6.0
Deep freezer	150 x 1 x 20	3.0
Geysers	2000 x 4	8.0
Fans/weighing balances	500 x 10	5.0
Air conditioners	2000 x 3 x 6	36.0
Total units		62.3

Table 5: Cost of electricity.

Particulars	Cost (Rs.) of 100 kg formulation of ERM/day				
	Control	Treatment (Optimum level of bind enhancing agents)			
		1% TSP	1% FF	0.1% GT	0.5% GA
Raw material cost	18192	18097	18122	18306	18547
Cost of machineries (depreciation cost)	154	154	154	154	154
Packaging cost	180	180	180	180	180
Labor cost	950	950	950	950	950
Cost of electricity	312	312	312	312	312
Cost of water	25	25	25	25	25
Rent	400	400	400	400	400
Maintenance	250	250	250	250	250
Total expenditure (Rs.)	20,463	20,364	20,389	20,573	20,814

Table 6: Total expenditure (Rs.).

Formulation	Calculation	Cost/kg
Control ERM	20463/84	=Rs.243.60/kg~ Rs. 244/kg
1% TSP incorporated ERM	20364/86	= Rs.236.79/kg~ Rs. 237/kg
1% FF incorporated ERM	20389/85	= Rs.239.87/kg~ Rs. 240/kg
0.1% GT incorporated ERM	20573/84	= Rs.244.92/kg~ Rs. 245/kg
0.5% GA incorporated ERM	20814/85	= Rs244.87/kg~Rs.245/kg

Table 7: Retail cost of extended restructured mutton chops.

Product yield

The cooking yield was around 86%, 88%, 87%, 86% and 87% for control and treatment product containing optimum levels of TSP, FF, GT and GA respectively. However, a safety margin of 1-2% is to be considered to compensate the losses that might occur during various steps of processing, packaging and marketing, considering the final yield of 84%, 86%, 85%, 84% and 85% for control and treatment product containing optimum levels of TSP, FF, GT and GA respectively.

Retail cost of extended restructured mutton chops

$$\text{Cost of one Kg product} = \frac{\text{Total expenditure}}{\text{Product yield}}$$

Therefore, the cost of 1 kg product was worked out to be Rs. 244, 237, 240, 245 and 245 for control and treatments including TSP, FF, GT and GA respectively (Table 7). The studies indicated that out of four bind enhancing agents, two of them i.e TSP and FF resulted in reduction in cost of ERM by Rs.6 and Rs.3 per kg, respectively as compared to control. Hence, it could be inferred that restructured mutton chops could be prepared with 10% extension and the quality can also be improved with 1% TSP incorporation to make it a profitable enterprise.

Conclusion

Although the demand for sheep meat has steadily increased over the last two decades and will continue to do so in the future, thus, leading to increased cost of the meat. Thus, the study was conducted to develop a mutton product which could be available to common man of the country where the prices of every material are touching the sky. Thus, results from this study revealed that an acceptable value added mutton product with Indian consumer appeal can be produced in the form of extended restructured mutton chops incorporated with bind enhancing agents which is, not only health promoting in the form of dietary fiber addition, but also cost effective product. Therefore, On the basis of production cost, 1% incorporation of TSP or FF could

be recommended as bind enhancing agents in extended restructured mutton chops. Besides the consumers, this also benefits the meat product manufacturers' with a profitable avenue in order to increase mutton sale.

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